Photometric Calibration of SkyMapper

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The Australian National University's SkyMapper

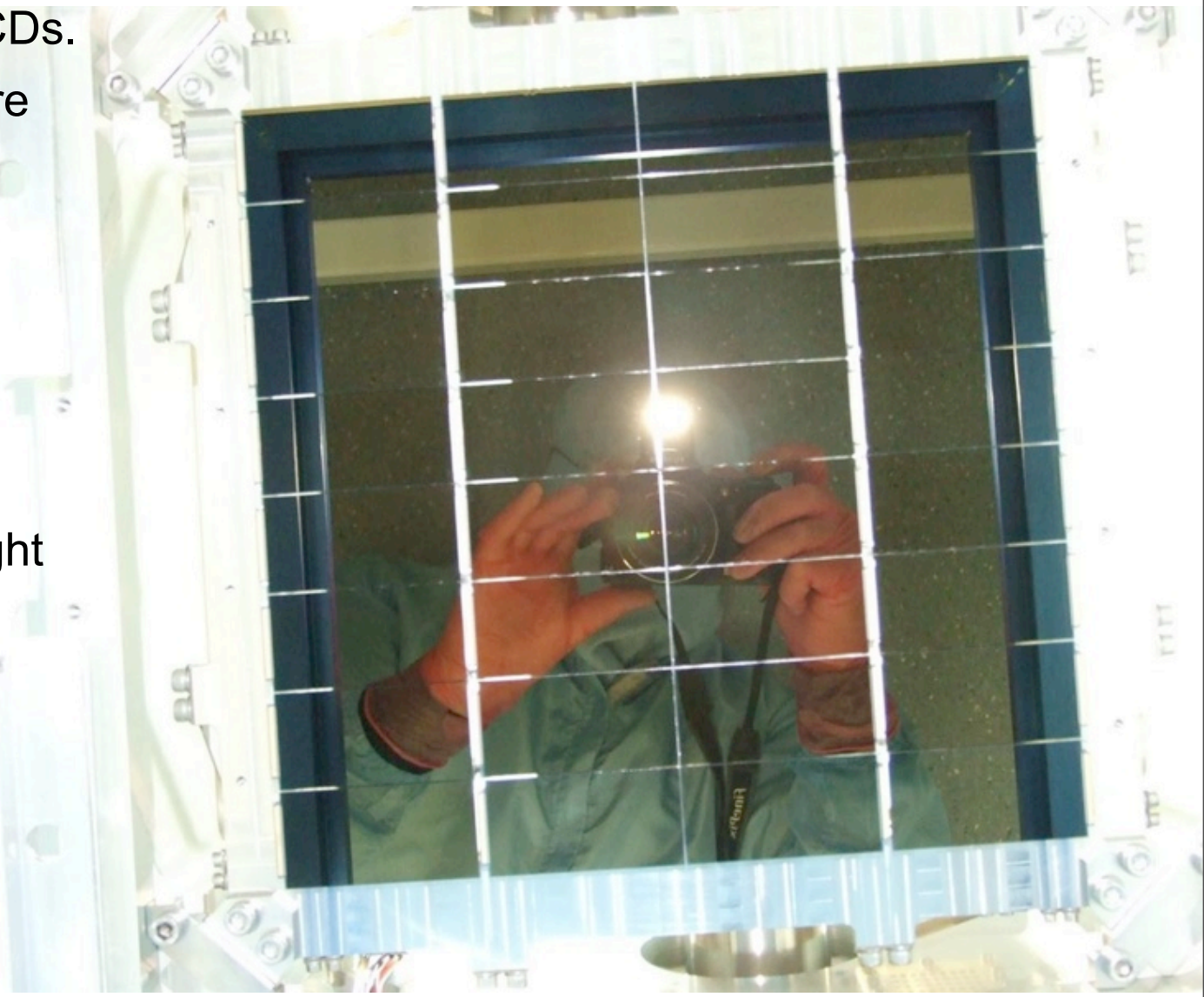
What is it?

- A southern Sloan photometric survey? No not entirely...
- 1.3m modified Cassegrain with a 5.7 square degree field of view
- Sited at the Australian National University's Siding Spring Observatory
- Fully automated, remote facility
- Data transferred via Gigabit link to ANU
- Aiming for science operation late 2008
- To conduct the Southern Sky Survey:
  - Five year
  - Multi-colour (6 filters)
  - Multi-epoch (6 exposures, each filter)
  - entire southern sky to g~23rd
- nightly data rate up to 0.8TB, data set of 324TB science + 150TB calibration
- Enable global access to 30TB via web
- Summary of program: Keller et al. 2007

The SkyMapper CCDs

- A mosaic of 32 2kx4k CCDs.
- 0.5” per pixel = 5.7 square degrees fov.
- Using new STARGRASP controllers
- Readout in ~15 seconds
- Readnoise ~5e^- @ 15 seconds

➡ 1000 square deg. per night



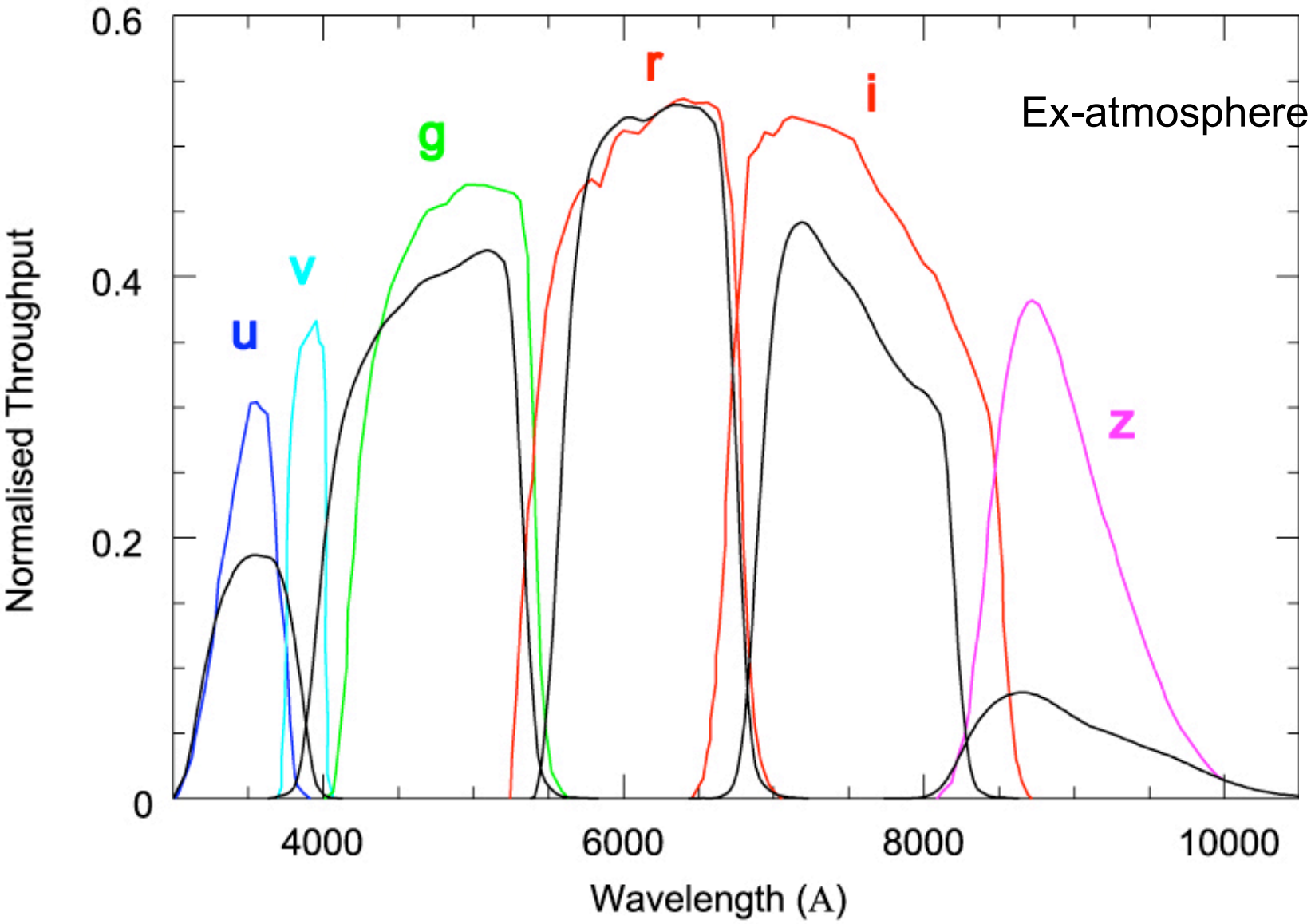
The Southern Sky Survey

- 2π coverage: 4096 fields observed in six filters, six times per filter
- Cadence: hours, days, weeks, months, years
- star/galaxy photometry to 3% globally (g<18)
- astrometry to 50 milliarcsec (absolute)
  - 36 images of each object over 5 years

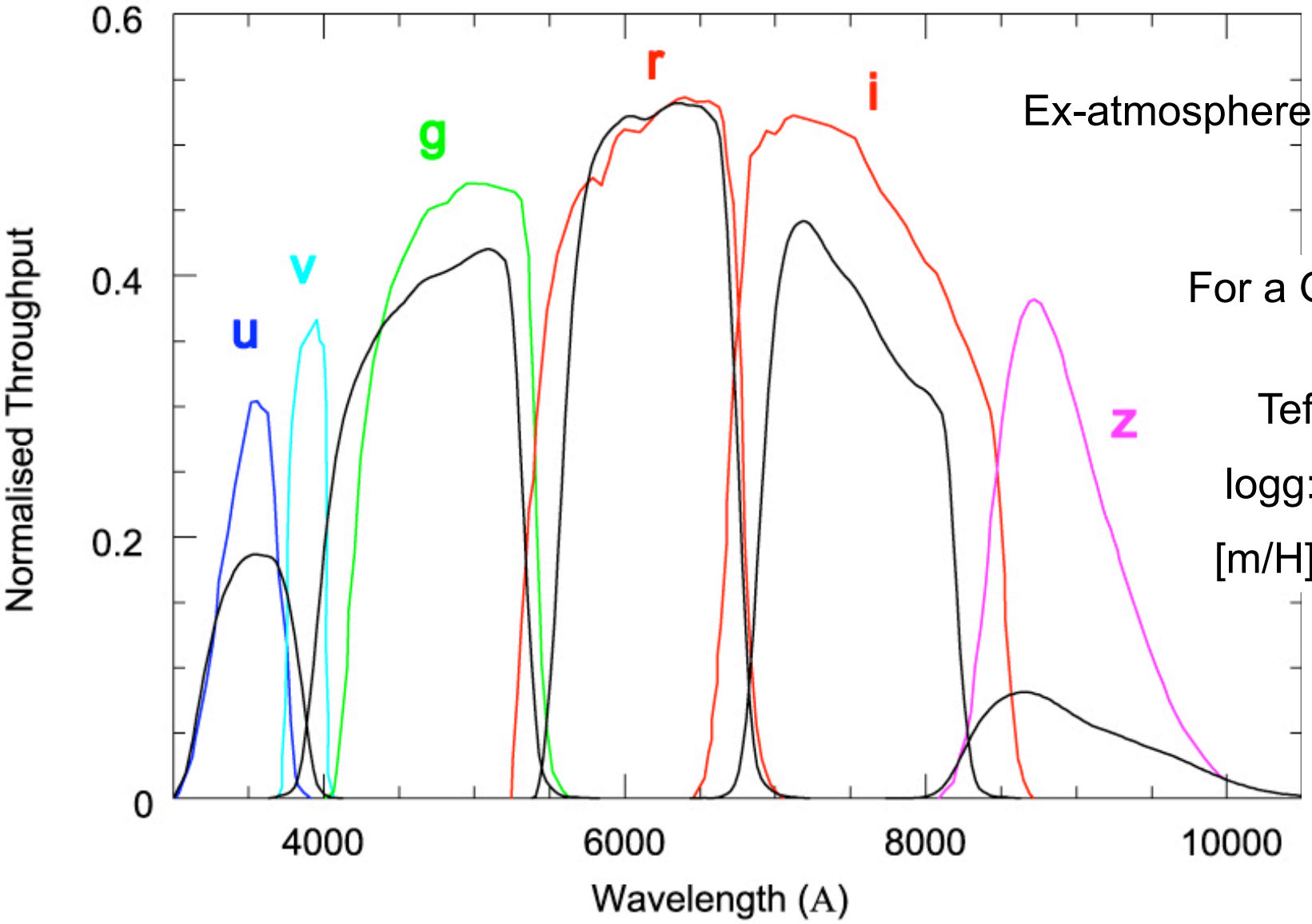
    ⇒ proper motions to ±2 mas/yr. (i.e. σvtan=25km/s at 2.5kpc)

    ⇒ parallax ±5 mas (i.e. 20pc σd=10%)
- survey complete in 5 years

SkyMapper Filter Set



SkyMapper Filter Set



Ex-atmosphere

For a G0 [m/H]=0 star

Teff: ±70K

logg: ±0.4dex

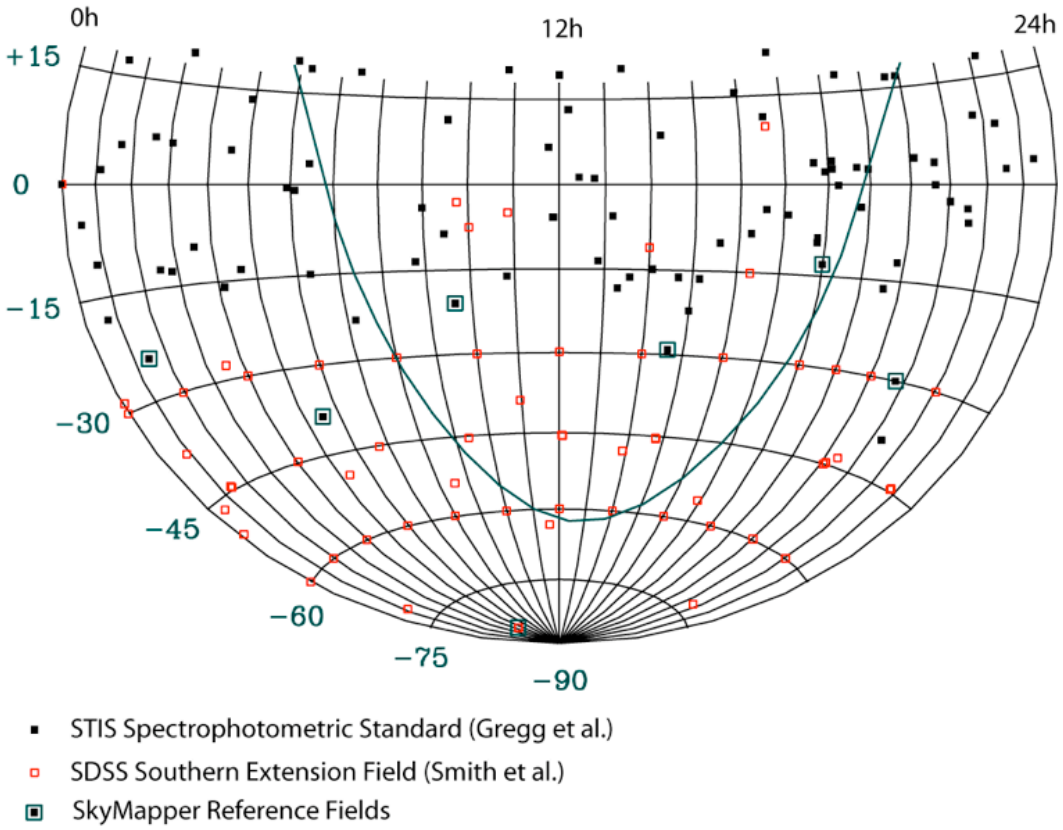
[m/H]: ±0.4dex

Expected Survey Limits

	u	*v*	*g*	*r*	*i*	*z*
1 epoch	21.5	21.3	21.9	21.6	21.0	20.6
6 epochs	22.9	22.7	22.9	22.6	22.0	21.5
Sloan Digital Sky Survey comparison	22.0	n/a	22.2	22.2	21.3	20.5

AB mag. for signal-to-noise = 5 from 110s exposures

SkyMapper's Calibration Plans



- Understanding the illumination correction is critical to our calibration efforts.

Establishment of Photometric + Astrometric Reference Fields

- We will establish 7 fields - 96 dithers covering 23 sq. deg. each
- Fields are chosen to have sufficient stellar densities and contain STIS spectrophotometric standards (Gregg et al.) and photometry from Hipparcos (Polar field contains Walraven standard).

SkyMapper's Calibration Plans

Absolute Primary Standards and Transformations to Other Systems

- We will have 6 primary standards to derive absolute photometry
- Photometry is in the natural system of SkyMapper (i.e. the mean for the mosaic of CCDs).
- Primary standards to define AB magnitudes that may then be transformed into your choice of photometric system.
- In our sweep of the sky we will have a large number of standards with which to define these transformations.
- Note: our ability to provide an estimate of logg enables us to avoid a major limitation of such transformations, that is, their dependency on surface gravity.

SkyMapper's Calibration Plans

The Five-Second Survey

- We will conduct the Five-Second Survey
  - cover 2pi in photometric conditions in 3 epochs of 5s.
  - cover magnitudes 7th - 16th.
  - During five-second survey nights observe the two highest reference fields and the polar field every 90 minutes.
- Anchor the deeper Main Survey to the Five-Second photometry and astrometry
  - This enables the Main Survey to proceed under non-photometric conditions.

SkyMapper's Calibration Plans

Astrometry

- We tie to the UCAC2 standards
- In establishing our reference fields one of our goals is to understand the astrometric distortions of our imager.
  - fit ZPN model for WCS
  - investigate distortions by looking at residuals derived after rotating the imager

SkyMapper's Calibration Plans

Monitoring Photometric Nature of the Night

- Establishing the photometric nature of a Five-Second night is critical.
- A monitoring strategy:
  - monitor the zeropoint of the system in each science frame utilising photometry for the stars contained within it.
  - At first we utilise a set of uvgriz magnitudes created from the merged NOMAD + 2MASS catalogues
  - This will be superseded later by the Five-Second survey itself.

Summary

- SkyMapper's Southern Sky Survey will provide a valuable resource for the southern sky
  - uniform optical survey deeper than SDSS limits over the entire southern sky (galactic plane included)
- On sky end of this year
- First data products late 2009
- Providing a freely available resource for the southern skies